

**DESIGNING SMARTHOME THROUGH INTERNET NETWORKING USING RASPBERRY PI COMPUTER**

**Tri Aristi Saputri <sup>1)</sup> Sofyan Rofiq<sup>2)</sup>,**  
Informatics Engineering of STMIK Dharma Wacana Metro  
Jl. Kenanga No.03 Mulyojati 16c Metro Barat Kota  
Metro Lampung 34125  
E-mail : [sofyan.rofiq@yahoo.com](mailto:sofyan.rofiq@yahoo.com)<sup>2)</sup>

\*Corresponding author  
Email :  
[arhlzty3@yahoo.co.id](mailto:arhlzty3@yahoo.co.id)<sup>1)</sup>

**Abstrac**

Human activity is now increasing rapidly, causing human beings to often leave home. With such busy activities, someone will have difficulty communicating with his/her electronical equipment at home. Electronical equipment at home can be controlled using internet network and through website called smarthome. The smarthome can facilitate the users in controlling their home electronical appliances such as lights, fans, and so forth. So as to reduce the waste of electricity when users forget to turn off their electronical equipment when they are outside the home or wherever the users are. Smarthome uses a raspberry pi computer that serves as a server that will connect between hardware and software controlled through the website as an interface that users use to enter input and generate output. The making of this web uses Raspbian operating system where the software used is python and HTML. The method used in developing software is waterfall method according to Sommerville. The features on this website are 16 buttons, if the button is green then the electronic equipment is on, and if the button is black then the electronic equipment is off.

**Keywords:** *Smarthome, Raspberry Pi, Website*

**1.0 INTRODUCTION**

Human activity is now increasing rapidly that causes people often leave home. With such activity in their daily live, someone will have difficulty in communicating or interacting with his/her electronical equipment at home. Let's say if someone travels far away and go home late, of course s/he must first prepare some things during his/her departure. One of them is turning on the lights before traveling. It will certainly take time and will waste electrical energy in vain. Based on the above explanation, it can be concluded that communication between home owners with their electronical equipment that is around the house is very important.

The rapid development of digital technology has also contributed to the development of computer technology. Today, many electrical devices work in an integrated manner with computer systems. This will certainly assist the work of humans in operating these electrical devices. One of today's growing research is about smarthome. The smarthome device is a device that has a very sophisticated automation system for controlling lights and temperature, a multimedia device to monitor and turn on a security system connected to a door or window and some other functions.

Smarthome has several benefits such as providing better comfort, safer safety and security, and save on electricity usage. By applying smarthome devices at home or offices, electronical devices will be able to work automatically according to user needs. Users can also monitor and control their electronic devices in the home remotely through a

communication channel such as through the Internet network. The use of raspberry pi computer that serves as a server that will connect between hardware and software controlled through the website.

## **2.0 THEORETICAL**

### **2.1 Smarthome**

Smarthome can be said as a residential extension of "building automation". This is related to activities and work at home that is automatically executed. Smarthome may include centralized lighting control, HVAC (heating, ventilation and air conditioning), equipment, and other systems, to provide comfort, safety, energy efficiency and better ease. A home automation system is able to integrate electrical devices at home with each other. The techniques used in the smarthome include an automation building with domestic control activities such as home entertainment systems, houseplant and watering garden system and others.

The device can be connected through a computer network to allow control with a personal computer and allows remote access from the internet. Through the integration of information technology with the home environment, systems and equipment that can communicate in an integrated manner resulting in comfort, energy efficiency and safety benefits.

### **2.2 Computer Network**

The Internet network is a combination of computer networks around the world and is the world's largest computer network that allows data communication between computers connected to the network. The Internet was originally a plan of the US Department of Defense in about 1960. Started from a project called the ARPANET or Advanced Research Project Agency Network. Several US universities including UCLA, Stanford, UC Santa Barbara and the University of Utah, were asked for help in working on this project and had initially successfully connected four computers at the different location of those universities.

In 1985, Modern Internet gained support when the National Science foundation formed NSFNET, connecting five super-computer centers at Princeton University, Pittsburgh, University of California, San Diego, University of Illinois at Urbana-Champaign, and Cornell University. Several regional networks were soon developed. Finally, the government moved the ARPANET parts to NSFNET.

### **2.3 Raspberry Pi**

Raspberry Pi is a credit card-sized computer connected to a TV and keyboard. This is a powerful little computer that can be used in electronics projects, and for many things desktop PCs do like spreadsheets, word processors, internet browsing, and games. It also plays high quality video. Raspberry Pi can be used by adults and children around the world to learn digital programming and making.

The idea behind a small and inexpensive computer for children appeared in 2006, when Eben Upton and colleagues at the University of Cambridge Computer Laboratory, including Rob Mullins, Jack Lang and Alan Mycroft, worried about the year-over-year decline in level A student skills who apply Computer Science in every academic year. In the 1990s where most children applied their hobby as programmers, but the scenes of the 2000s were very different. Most of them only have the skills to design a web. From 2006 to 2008, Eben designed several versions of what has now become Raspberry Pi.

### **2.4 Python**

Python is a multipurpose interpretative programming language. Unlike other languages that are hard to read and understand, Python places more emphasis on code readability to make it easier to understand the syntax. This makes Python very easy to learn both for beginners and for those who already master other programming languages. This language first appeared in 1991, designed by someone named Guido van Rossum. Until now Python is still developed by the Python Software Foundation. The python language supports almost all operating systems, even for Linux operating systems, almost all of the districts

already include Python in it.

## 2.5 HTML

HTML stands for HyperText Markup Language. HTML is a text file written using certain code rules to then be presented to the user through a web browser application. Any information that appears on the web is always created using HTML code. Therefore, HTML documents are often referred to as web pages (web pages). To create an HTML document, we are not dependent on a particular application; because HTML documents can be created using any Text Editor app, either Notepad (for MS Windows environments), Emacs or Vi Editor (for Linux environments), and so on.

## 3.0 METHODOLOGY

### 3.1 Data Collecting Method

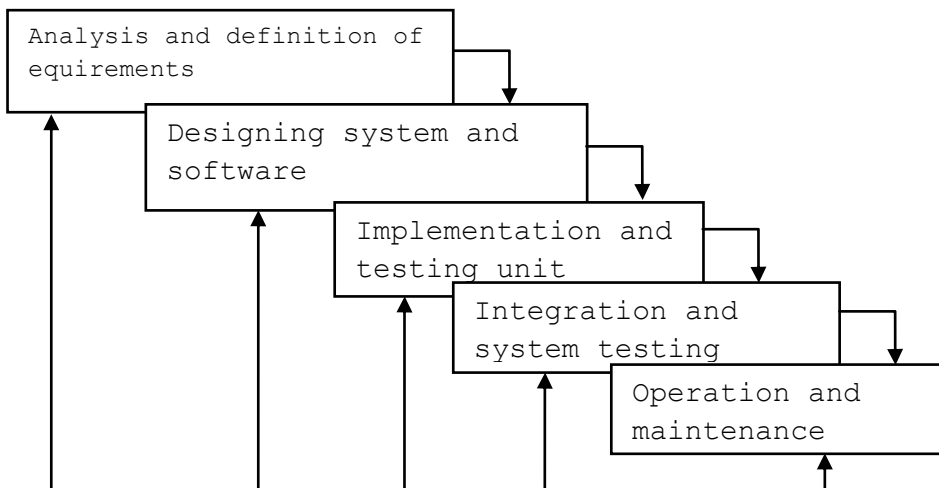
The method in collecting the data in this research are as follow:

#### ❖ Literatur Study

The method of collecting the data in literature study are reading literature, journals, papers and reading sources that support the topic of this research. Especially books that discuss about smarthome, raspberrypi, python and software development.

### 3.2 Software Development Method

The method of software development used is using waterfall method. The phases in Waterfall method according to Sommerville are used only until the implementation and testing unit. The processes contained in the waterfall method according to Sommerville are:



Picture 3.1 Waterfall Method According to Sommerville

1. *Analysis and Definition of Requirements* Collecting complete information needs from journals or books that discuss about smarthome, raspberry pi, website and python. The analyses of hardware requirements required in this application are raspberry pi computer, relay module, power supply, lamp and fan, and for software requirement analysis is python and website.
2. *Designing System and Sooftware* Designing system that will be built using UML, that is use-case diagram and activity diagram. This system will combine electrical circuits in electronic equipment and internet network into a single unit in the control function. Users can control it by turning on and off electronic equipment, and can prevent the occurrence of electrical zipper. This system is controlled by python in raspberry pi connected to the internet, as well as a website for electronic equipment control interface for users.
3. *Implementation and Testing Unit* The form of the implementation of the system in the form of writing programs performed on raspberry pi computer using python language and commands that exist on the operating system raspbian, and writing

websitemenggunakan HTML program. Once python is made it is necessary to test several units contained in the system using blackbox testing. By asking questions based on system functionality created. Functionality is appropriate, but still in error.

## 4.0 RESULTANTS AND DISCUSSION

### 4.1. Problem Analysis

This smarthome development uses raspberry pi, internet network and website which is a mechanism designed in such a way and used only for controlling home electronics at home. As for the research conducted, there are problems that occur so the system is made as follows:

1. Lack of homeowner's comfort when they went traveling for an indefinite period of time.
2. Limited distance to control electronic equipment from a certain distance.

Therefore, it takes a solution to handle the happening problems that is needed a smarthome system that aims to:

1. Giving comfort to homeowners when they went traveling for an indefinite period.
2. Make it easy to control electronical equipment at home remotely through the website.

### 4.2. System Analysis

Development of smarthome is a system used to control electronic equipment at home. This system will combine electrical circuit in electronic equipment and internet network combined with raspberry pi computer. With the construction of this system the user does not have to control the lights or fans by coming to the center of the control of lights or fans and other electronic equipment when we went away. Users can control the use of other electronical equipment controlled by raspberry pi computer that is connected to the internet network. The following is the analysis of existing systems on the smarthome system:

1. Turn the connected equipment on and off at home by pressing the ON-OFF button on the website.
2. Smarthome is controlled via internet network using raspberry pi computer.
3. The website will display the status of ON-OFF electronic equipment when turned on and off as monitoring by the home owner.

### 4.3. Hardware Requirements Analysis

The hardware that will be used based on the minimum requirement that must be fulfilled is:

#### a. RaspberryPi Hardware

This system requires the raspberry pi hardware as a processing tool between input and output devices. Specifications of raspberry pi hardware are shown in Table 1.

**Tabel 1. Specifications of Raspberry Pi Hardware**

| Devices              | Specification   |
|----------------------|---|
| Computer             | <i>Raspberry Pi 3 Model B</i>   |
| System-ON-Chip (SoC) | <i>Broadcom BCM2837</i>   |
| CPU                  | <i>4× ARM Cortex-A53, 1.2GHz</i>  |
| GPU                  | <i>Broadcom VideoCore IV</i>  |
| RAM                  | <i>1GB LPDDR2 (900 MHz)</i>   |
| Networking           | <i>10/100 Ethernet, 2.4GHz 802.11n wireless</i>   |
| Bluetooth            | <i>Bluetooth 4.1 Classic, Bluetooth Low Energy</i>  |
| Storage              | <i>microSD</i>  |
| GPIO                 | <i>40-pin header, populated</i>   |
| Ports                | <i>HDML, 3.5mm analogue audio-video jack, 4× USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)</i> |

#### b. Additional Hardware

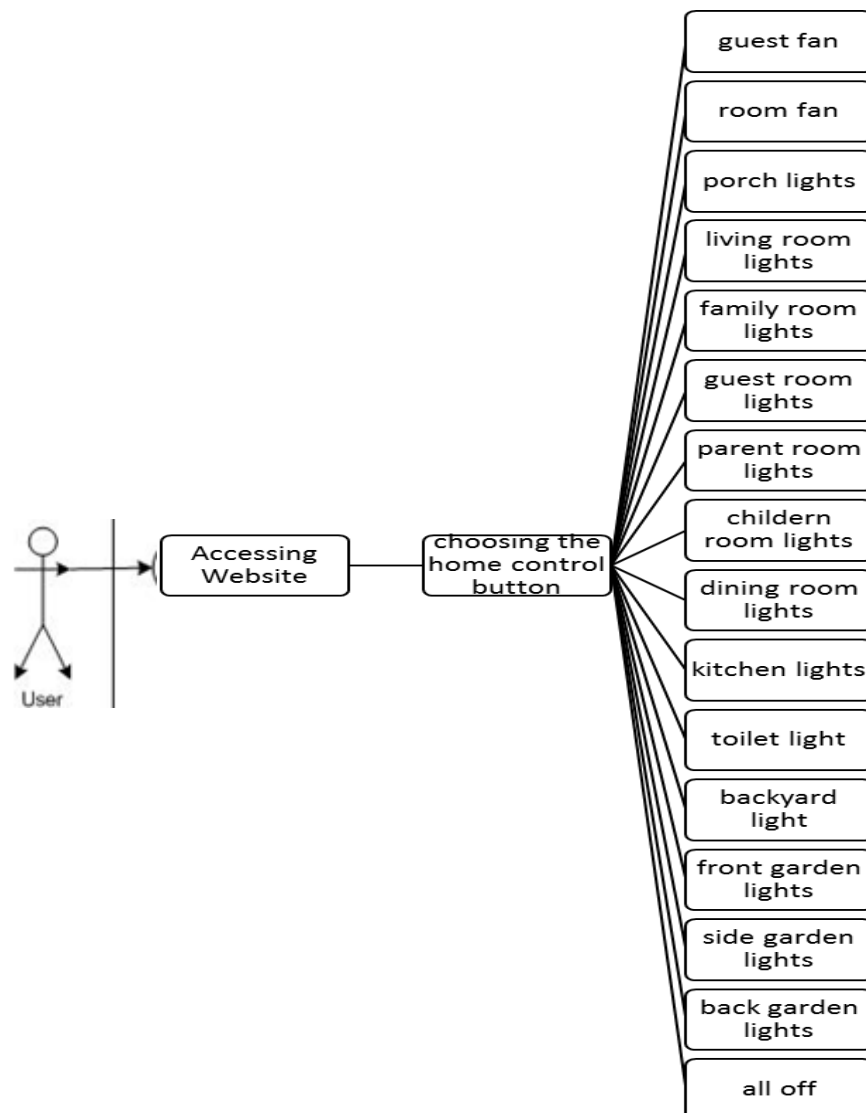
The specifications on the additional hardware used are shown in Table 2.

**Table 2. The Specifications on the Additional Hardware**

| Hardware              | Specification      |
|-----------------------|--------------------|
| Power Supply Computer | Power Supply 220 V |
| Dioda                 | 1n 4148            |
| Relay                 | 16 channel         |
| Lamp                  | 3 lamps (1 watt)   |
| Hardware              | Specification      |
| Turn signal           | 12 items (12 volt) |
| Fan                   | 2 fans             |

#### 4.4. Use Case Diagram Website

Use Case diagram is a diagram showing the functionality of a system or class and how the system interacts with the outside world and describes the system functionally visible to the user. From the identification of the actors involved above then the use case diagram website can be seen in Figure 4.1.



**Picture 1. Use Case Diagram Website**

### 1. Description of Actor

An actor is an abstraction of people and systems that activate the function of the target system. Based on Use Case Diagram in Figure 4.2, the description of the actor can be seen in Table 3.

**Tabel 3. Description of Actor**

| No. | Actor | Description  |
|-----|-------|--|
| 1.  | User  | an actor who can act as a person who uses the website to control electrical equipment at home. |

### 2. Description of UseCase

The description of UseCase in system can be seen in the following tabel 4.

**Tabel 4. Description of UseCase**

| No. | Use Case             | Description  |
|-----|----------------------|--|
| 1.  | Guest fan            | This functionality is used by the user to enable and disable the status of the guest fan.            |
| 2.  | Room fan             | This functionality is used by the user to enable and disable the status of the room fan.             |
| 3.  | Porch lights         | This functionality is used by the user to enable and disable the status of the porch lights.         |
| 4.  | Living room lights   | This functionality is used by the user to enable and disable the status of the living room lights.   |
| 5.  | Family room lights   | This functionality is used by the user to enable and disable the status of the family room lights    |
| 6.  | Guest room lights    | This functionality is used by the user to enable and disable the status of the guest room lights.    |
| 7.  | Parent room lights   | This functionality is used by the user to enable and disable the status of the parent room lights.   |
| 8.  | Children room lights | This functionality is used by the user to enable and disable the status of the children room lights. |
| 9.  | Dining room lights   | This functionality is used by the user to enable and disable the status of the dining room lights.   |
| 10. | Kitchen lights       | This functionality is used by the user to enable and disable the status of the kitchen lights.       |
| 11. | Toilet lights        | This functionality is used by the user to enable and disable the status of the toilet lights.        |
| 12. | Backyard lights      | This functionality is used by the user to enable and disable the status of the backyard lights.      |
| 13. | Front garden lights  | This functionality is used by the user to enable and disable the status of the front garden lights.  |
| 14. | Side garden lights   | This functionality is used by the user to enable and disable the status of the side garden lights.   |
| 15. | Back garden lights   | This functionality is used by the user to enable and disable the status of the back garden lights.   |
| 16. | All OFF              | This functionality is used to enable device status to be all disabled.                               |

## 4.5. Implementation

### 4.5.1. The Results of Home Page Views

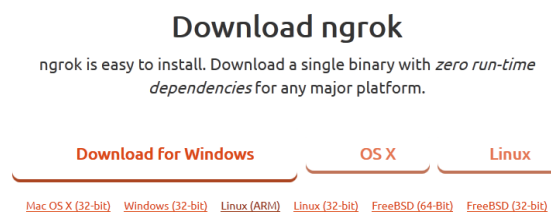
Users can see the main page on this website, on the main page user can operate the use of lights in every room and fan. Home page views can be seen as follows.



Picture 2. Home Page Views

### 4.5.2. Instalasi Tunnels Ngrok

Download first the file ngrok in <http://ngrok.com>. Then select the platform you use. Here the researcher uses Raspbian OS, then the researcher select Linux (ARM) then click on the option.



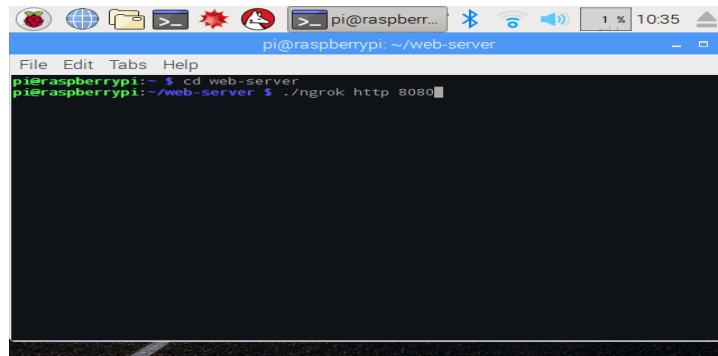
1. Once downloaded the ngrok file will shape in zip. On Linux or OSX you can unzip it from the terminal with the following command. In Windows, simply double-click ngrok-stable-linux-arm.zip

```
$ unzip /path/to/ngrok-stable-linux-arm.zip
```

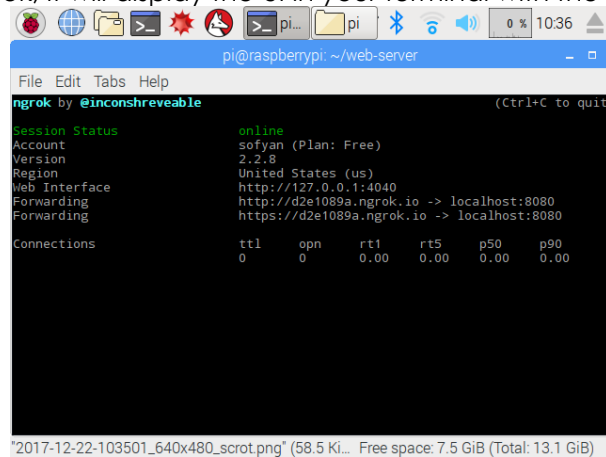
2. After being unzipped, then copy the file to a folder ngrok webserver who want in online. Suppose the researcher will copy it into the web-server's recording.

```
$ cp /home/pi/web-server
```

3. Going to the next stage requires you to register an account at <https://dashboard.ngrok.com/user/signup>. After you sign up, you need to configure the ngrok with authtoken that appears on your dashboard. This will give you access to account-specific features. Ngrok has a simple 'authtoken' command to make this easy. `$ ./ngrok authtoken <YOUR_AUTHTOKEN>`
4. Then we will expose the web server running on your local computer to the internet. Just say ngrok port what your web server is in use. Here the researcher uses port 8080



5. As you start to ngrok, it will display the UI in your terminal with the public URL tunnels.



#### 4.6. Testing the System

Implementation and testing of the system is the most important thing in making an application that aims to find errors or deficiencies in the application to be tested. Implementation and testing intend to know whether the application made has met the performance in accordance with the design goals that have been made.

Black box is a testing method that will be used to test the new system, black box testing focused on testing functional requirements on the website that has been built. Testing to be done is to test the black box.

##### 4.6.1. Blackbox Testing Scenario

Further explanation of application testing scenario can be seen in the following table.

**Tabel 5. Scenario Testing**

| No | Testing Class                          | Test Item                                   | Type of testing |
|----|--|---|-----------------|
| 1. | Turn the fan on and off                | Button ON turns on the guest fan            | BlackBox        |
|    |  | Button OFF turns off the guest fan          |                 |
| 2. | Turn the room fan on and off           | Button ON turns on the room fan             | BlackBox        |
|    |  | Button OFF turns off the room fan           |                 |
| 3. | Turn the porch lights on and off       | Button ON turns on the porch lights         | BlackBox        |
|    |  | Button OFF turns off the porch lights       |                 |
| 4. | Turn the living room lights on and off | Button ON turns on the living room lights   | BlackBox        |
|    |  | Button OFF turns off the living room lights |                 |
| 5. | Turn the family room lights on and off | Button ON turns on the family room lights   | BlackBox        |
|    |  | Button OFF turns off the family room lights |                 |
| 6. | Turn the guest room lights on and      | Button ON turns on the guest                | BlackBox        |



|     |  |   |          |
|-----|--|---|----------|
|     | off                                      | room lights                                       |          |
|     |  | Button OFF turns off the guest room lights        |          |
| 7.  | Turn the parent room lights on and off   | Button ON turns on the parent room lights         | BlackBox |
|     |  | Button OFF turns off the parent room lights       |          |
| 8.  | Turn the children room lights on and off | Button ON turns on the children room lights       | BlackBox |
|     |  | Button OFF turns off the children room lights     |          |
| 9.  | Turn the dining room lights on and off   | Button ON turns on the dining room lights         | BlackBox |
|     |  | Button OFF turns off the dining room lights       |          |
| 10. | Turn the kitchen lights on and off       | Button ON turns on the kitchen lights             | BlackBox |
|     |  | Button OFF turns off the kitchen lights           |          |
| 11. | Turn the toilet lights on and off        | Button ON turns on the toilet lights              | BlackBox |
|     |  | Button OFF turns off the toilet lights            |          |
| 12. | Turn the backyard lights on and off      | Button ON turns on the backyard lights            | BlackBox |
|     |  | Button OFF turns off the backyard lights          |          |
| 13. | Turn the front garden lights on and off  | Button ON turns on the front garden lights        | BlackBox |
|     |  | Button OFF turns off the front garden lights      |          |
| 14. | Turn the side garden lights on and off   | Button ON turns on the side garden lights         | BlackBox |
|     |  | Button OFF turns off the side garden lights       |          |
| 15. | Turn the back garden lights on and off   | Button ON turns on the back garden lights         | BlackBox |
|     |  | Button OFF turns off the back garden lights       |          |
| 16. | Turn the All OFF on and off              | Button All OFF turns off all electrical equipment | BlackBox |
| 17. | Connection                               | Internet Connection                               | BlackBox |

## 5.0 CONCLUSION

Based on the discussion of analysis, design, implementation up to the test phase, then it can be concluded and suggested for control of this electrical equipment in order to achieve better utilization.

### 5.1. Conclusion

Based on the results obtained from the research conducted in reference to the objectives of the study, it can be concluded that:

1. The use of raspberry pi computer is very efficient to control electrical equipment remotely.
2. For the application of smarthome using raspberry pi computer is very appropriate, because in accordance with the needs of the system that aims to control electrical equipment at home.

### 5.2. Suggestion

In order for research on this smarthome can be developed again not only control of electrical appliances but also include home security and so forth.

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